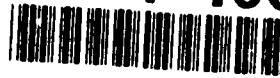


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Digital Altimeter Setting Indicator (DASI) Operational Test and Evaluation (OT&E) Integration and OT&E Operational Test Procedures

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16. Abstract <p>The Digital Altimeter Setting Indicator (DASI) is a system which measures the atmospheric pressure and converts the measured pressure value into the actual sea level pressure based on the United States (U.S.) Standard Atmospheric Table. The value then computed is known as the Altimeter Setting Indicator (ASI) value and is presented to the operator, who is air traffic control (ATC), in a digital format, e.g., 29.50 inches of mercury (inHg). The ASI value is then transmitted by the air traffic controller to an aircraft pilot for use in setting the altimeter in the aircraft. If a perfectly calibrated altimeter is set to the ASI value existing at any given station whose elevation is designated as Hp, the pointer of the altimeter instrument will indicate an altitude of Hp when the instrument is at the altitude of the sensor in the DASI system. (Hp is an elevation in geopotential meters above mean sea level of the altimeter setting indicator pressure sensor.)</p> <p>The purpose of this Operational Test and Evaluation (OT&E) Test Procedure is to describe the Test and Evaluation activities which will ensure the DASI system meets all the requirements of the DASI Specification, FAA-E-2569B, and integrates properly into the National Airspace System (NAS). The OT&E procedure includes the test cases, responsibilities, Test Support Hardware and Software, and Test Conduct associated with the testing of the DASI. The DASI test is developed and executed in accordance with the current FAA Test and Evaluation Policy Order, FAA Order 1810.4B.</p>			
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EXECUTIVE SUMMARY

The Digital Altimeter Setting Indicator (DASI) is a system which measures the atmospheric pressure and converts the measured pressure value into the actual sea level pressure based on the United States (U.S.) Standard Atmospheric Table. The value then computed is known as the Altimeter Setting Indicator (ASI) value and is presented to the operator, who is air traffic control (ATC), in a digital format, e.g., 29.50 inches of mercury (inHg). The ASI value is then transmitted by the air traffic controller to an aircraft pilot for use in setting the altimeter in the aircraft. If a perfectly calibrated altimeter is set to the ASI value existing at any given station whose elevation is designated as H_p , the pointer of the altimeter instrument will indicate an altitude of H_p when the instrument is at the altitude of the sensor in the DASI system. (H_p is an elevation in geopotential meters above mean sea level of the altimeter setting indicator pressure sensor.)

The DASI is designed to compute and transmit/display ASI with accuracy of ± 0.005 inHg over any value in the range of the instrument. Built-in test functions are provided in the equipment to monitor for computation and data transmission errors, warmup, and other fault conditions; with displays providing indication to the operator.

The Sensor/Translator (S/T) unit is designed for rack mounting with plug connections on the rear panel. The front panel has several controls. The first control is for adjusting the system to the site elevation. The second control is for the addition of a correction into the display of ASI. The last control is for the lamp test. The front panel also includes a digital readout of the ASI value (5 digit). The S/T unit is capable of providing output to 50 digital displays via its Frequency Shift Keying (FSK) output. A fitting is provided on the rear surface of the S/T for venting the pressure sensing device to the outside atmosphere.

The Digital Display Panel (DDP) contains a 4-digit display and is the unit viewed by the operator. The ASI value is presented to the operator on a digital display providing the reading in inches and hundredths of inches of mercury. The unit is equipped with an intensity control to allow the background brightness of the digits to be adjusted to the level required for the best legibility under ambient conditions. It is also equipped with a display test switch which, when operated, causes all segments of the DDP on the display panel to be illuminated.

The purpose of this Operational Test and Evaluation (OT&E) Test Procedure is to describe the Test and Evaluation activities which will ensure the DASI system meets all the requirements of the DASI Specification, FAA-E-2569B, and integrates properly into the National Airspace System (NAS). The OT&E procedure includes the test cases, responsibilities, Test Support Hardware and Software, and Test Conduct associated with the testing of the DASI. The DASI test is developed and executed in accordance with the current FAA Test and Evaluation Policy Order, FAA Order 1810.4B.

1. INTRODUCTION.

The Digital Altimeter Setting Indicator (DASI) is a system which measures the atmospheric pressure and converts the measured pressure value into the actual sea level pressure based on the United States (U.S.) Standard Atmospheric Table. The value then computed is known as the Altimeter Setting Indicator (ASI) value and is presented to the operator, who is air traffic control (ATC), in a digital format, e.g., 29.50 inches of mercury (inHg). The ASI value is then transmitted by the

air traffic controller to an aircraft pilot for use in setting the altimeter in the aircraft. If a perfectly calibrated altimeter is set to the ASI value existing at any given station whose elevation is designated as Hp, the pointer of the altimeter instrument will indicate an altitude of Hp when the instrument is at the altitude of the sensor in the DASI system. (Hp is an elevation in geopotential meters above mean sea level of the altimeter setting indicator pressure sensor.)

1.1 PURPOSE.

The DASI system provides the function of computation and display of the ASI for the air traffic controller. The purpose of this Operational Test and Evaluation (OT&E) Test Procedure is to describe the Test and Evaluation activities which will ensure the DASI system meets all the requirements of the DASI Specification, FAA-E-2569B, and integrates properly into the National Airspace System (NAS). The OT&E procedure includes the test cases, responsibilities, Test Support Hardware and Software and Test Conduct associated with the testing of the DASI. The DASI test is developed and executed in accordance with the current FAA Test and Evaluation Policy Order, FAA ORDER 1810.4B.

1.2 SCOPE.

This document contains the OT&E test procedures for the DASI system. These procedures will provide the framework for testing all the DASI Specification requirements. The procedure will be updated as requirements are defined or modified.

2. REFERENCE DOCUMENTS.

This section lists the applicable documentation and reference material pertinent to the content and conduct of these test procedures.

2.1 FAA DOCUMENTS.

2.1.1 FAA Specification.

FAA-E-2569B Altimeter Setting Indicator, Digital Readout System
Specification, February 19, 1993

FAA-G-2100e Electronic Equipment, General Requirements,
March 11, 1987

2.1.2 FAA Standards.

FAA-STD-024a Preparation of Test and Evaluation Document,
August 17, 1987

FAA-STD-013b Quality Control Program Requirements,
September 28, 1989

2.1.3 FAA Orders.

1810.4B FAA NAS Test and Evaluation Policy,
October 22, 1992

2.1.4 Others.

Digital Altimeter Setting Indicator (DASI)
Test and Evaluation Master Plan, July 7, 1993

3. OT&E TEST PHILOSOPHY.

The NAS OT&E testing will verify that DASI meets the requirements identified in the Test Verification Requirements Traceability Matrix (TVRTM). (See appendix A.) These requirements reflect the DASI Specification Requirements. The test procedures are written to ensure that these requirements are adequately verified. The testing will be conducted to verify that the DASI accurately reports ASI to ATC. The ASI value is then transmitted by ATC to an aircraft pilot for use in setting the altimeter in the aircraft.

3.1 TEST CASES.

The test cases to be tested and verified during DASI testing are:

- A. Pretest Inspection
- B. Start up
- C. Lamp Intensity
- D. FSK Output and Component Interchangeability
- E. Calibration
- F. Error Detection
- G. Maintainability Evaluation
- H. Lightning Protection/Electromagnetic Compatibility
- I. Meteorological Performance Evaluation

3.2 LOCATION AND SCHEDULE.

This section describes the DASI testing location and schedule. The DASI OT&E testing is scheduled for August 16 through 20 at Page Field (FMY), Fort Myers, Florida, by ACW-200A.

4. TEST CASE DESCRIPTIONS.

A brief description of each test case is provided below, while the actual procedures are provided in appendix B.

4.1 TEST CASE A PRETEST INSPECTION.

The Pretest Inspection is a visual inspection of the DASI system. The inspection verifies that (1) the system meets the general requirements of FAA-G-2100e, (2) a pressure connection is provided to permit connection to ancillary equipment, and (3) the DASI system is comprised of 1 sensor translator unit and up to 50 remote displays.

If the Quality Reliability Officer (QRO) has already verified (signed off) on this inspection during Development Test and Evaluation (DT&E), then these inspections will be waived.

4.2 TEST CASE B STARTUP.

This startup test case will activate the Sensor/Translator (S/T) and the Digital Display Panel (DDP). When the elevation has never been entered into the system and a calibration is required, several requirements are tested. (See appendix B).

4.3 TEST CASE C LAMP INTENSITY.

This test demonstrates that the 4-digit DDP is plainly legible when observed under lighting conditions varying from darkness to 10,000-foot candles from a distance of 20 feet and any viewing angle 60° from in front of the display. This test will be run both during the day time and the evening hours to evaluate the illumination and viewing distance.

4.4 TEST CASE D FREQUENCY SHIFT KEYING OUTPUT AND COMPONENT INTERCHANGEABILITY.

This case will verify the output from the S/T unit to be digital data, American Standard Code for Information Interchange (ASCII) coded, in serial Frequency Shift Keying (FSK) format. It will show that the four most significant digits of the DDP unit ASI display are provided by means of decoding the FSK output. The test will also demonstrate that like system components are interchangeable.

4.5 TEST CASE E CALIBRATION.

This test case will verify the calibration requirements for the DASI system. The tests will be at selected points not greater than +/- 0.005 inHg for any value in the range of the instrument. The provision to permit recalibration by the Federal Aviation Administration (FAA) is tested.

4.6 TEST CASE F ERROR DETECTION.

This test will verify the computation and serial transmission errors. Upon power on, the DDP will display ERROR until three consecutive matching ASI values arrive from the S/T unit. Parity is checked on all incoming words and a parity error will cause the ERROR to be displayed. If no messages arrive at the DDP within 2.5 minutes, the DDP will display ERROR.

The test demonstrates that the S/T unit requires no warmup period and after self test reads the pressure sensor and displays the correct ASI. A computation check is run on a known ASI value before each calculation is made to verify the integrity of the system. ERROR will be displayed if the test computation produces an invalid result.

4.7 TEST CASE G MAINTAINABILITY EVALUATION.

This test will demonstrate the maintainability evaluation which determines if a DASI trained technician can restore the system from a failure mode to operational status within 30 minutes.

4.8 TEST CASES H LIGHTNING PROTECTION/ELECTROMAGNETIC COMPATIBILITY.

Electromagnetic compatibility testing will be accomplished during Integration and Operational testing to the extent of observing for electromagnetic incompatibility in the use of the equipment.

4.9 TEST CASE I METEOROLOGICAL PERFORMANCE EVALUATION.

This test will ascertain the accuracy of the DASI performance and ensure consistency between the DASI system and a certified sensor. The operational test is required to verify that the sensor provides a sensor accuracy within +/- 0.005 inHg in an operational environment.

5. TEST CONDUCT RESPONSIBILITIES.

This section describes the key organizations involved in the testing activities. The following section describes the organizational roles and responsibilities for test conduct.

5.1 ACW-200A TEST RESPONSIBILITIES.

ACW-200A is responsible for the conduct of all testing activities. The conduct of DASI OT&E testing requires the following personnel to support the test effort:

a. Associate Program Manager for Test (APMT). The DASI APMT organization (ACW-200A) is responsible for the overall management of the OT&E test effort. The APMT has ultimate responsibility for (1) developing OT&E requirements, plan, procedures, and report; (2) coordination of the test documentation; (3) conduct of OT&E testing; (4) test documentation management; (5) appointment of Test Director; (6) presenting unresolved test issues and problems to the Test Policy and Planning Review Committee (TPRC); and (7) providing assessments and recommendations to the Deployment Readiness Review Executive Committee (DRR EXCOMM). In addition, the APMT will provide direct or appointed leadership and manpower, as required, to support testing. The APMT will be responsible for providing the Final Test Report to the Program Manager (PM).

b. Test Director. The Test Director is responsible for upholding test schedules and maintaining authority at the test site during test conduct. Also, responsible for ensuring that (1) test personnel are available and properly trained to conduct the required tests; (2) the required equipment is available and in working order at the designated test site; (3) requirements for on-site test support personnel; (4) test activities are performed within the approved schedule in accordance with approved test procedures; (5) noted test discrepancies are logged and appropriate remedial action for resolution of the test problems is recommended; and (6) test data for analysis is collected and test results are documented. In addition, the Test Director is responsible for briefing the test team, defining the necessary test team assignments, coordinating the test resources, assuring proper recording of the test results, red-lining test procedures to reflect as tested activities, coordinating Program Trouble Reports, participating in test execution, and debriefing the test team.

c. Test Engineer(s). Responsible for performing and fulfilling various test duties during the conduct of testing, and recording anomalies and comments in the test log during test conduct. Responsibilities include (1) bringing up the system; (2) carrying out test setups and execution of runs; and (3) operating the test equipment.

d. Test Witnesses. Technically qualified test witnesses will be assigned by the Test Director, on an as needed basis, to monitor and record activities for specific DASI OT&E test activities. Qualified Test Witnesses may be solicited from any FAA or support organization which offers a particular or required DASI expertise, as determined by the APMT. Test witnesses will maintain the data sheets and test logs. The test witnesses will assist the Test Director and test engineers in verifying that test observations and/or measurements are properly recorded.

6. TEST SUPPORT HARDWARE AND SOFTWARE.

A variety of tools will be employed in the test conduct of OT&E testing of the DASI system. Specific test support hardware and software is required for some of the tests outlined in appendix B.

In general, the following test support hardware and software is required:

- a. A Photometer to measure the displays intensity and the ambient light.

- b. A stop watch to time the DDP ERROR response to no signal from the S/T when power is removed.
- c. An oscilloscope to monitor the DDP test point for observing the FSK output data.
- d. A portable pressure standard to evaluate the ASI value of the S/T unit.
- e. A variable pressure test fixture used to adjust the ASI value.
- f. A disk with DASI test software.
- g. IBM compatible computer with/windows.
- h. DASI test fixture used with the IBM compatible and the DDP.

7. TEST OPERATION INSTRUCTION.

The DASI system Test Director will determine test start, termination, restart etc.. Each test case will contain specific instructions regarding test setup, conduct termination, and restart.

Each test sequence will satisfy one or more TVRTM requirement(s). These requirements will be identified within each test case. The test cases contain separate test procedures that can be performed on a stand-alone basis.

7.1 TEST CONDUCT.

Each test case contains detailed step-by-step test procedures and where applicable a pass/fail block.

7.2 TERMINATION AND RESTART OF THE TEST.

Each test case will be conducted on a stand-alone basis. Determination of test start/stop will be made by the Test Director.

8. TEST DATA REDUCTION AND ANALYSIS.

N/A

9. ACRONYMS AND ABBREVIATIONS.

APMT	Associate Program Manager for Test
ASCII	American Standard Code for Information Interchange
ASI	Altimeter Setting Indicator
ATC	Air Traffic Control
DASI	Digital Altimeter Setting Indicator
DDP	Digital Display Panel
DRR EXCOMM	Deployment Readiness Review Executive Committee
DT&E	Development Test and Evaluation
FAA	Federal Aviation Administration
FMY	Page Field, Fort Myers, Florida
FSK	Frequency Shift Keying
inHg	inches of mercury
ms	millisecond
LRU	Line Replaceable Unit
MTTR	Mean Time to Repair
NAS	National Airspace System
OT&E	Operational Test and Evaluation
PM	Program Manager
QRO	Quality Reliability Officer
RSW	Southwest Regional Airport
S/T	Sensor/Translator
TEMP	Test and Evaluation Master Plan
TPRC	Test Policy and Planning Review Committee
TVRTM	Test Verification Requirements Traceability Matrix
U.S.	United States
VAC	volts alternating current
VRTM	Verification Requirements Traceability Matrix

APPENDIX A

TEST VERIFICATION REQUIREMENTS TRACEABILITY MATRIX (TVRTM)

TEST REQUIREMENT NUMBER	SPEC REFERENCE NUMBER	SPECIFICATION REQUIREMENTS	OT&E O	OT&E I	COMMENTS
0003.050	3.1.1	DASI shall consist of controls for adjusting the system to site elevation.	D	X	Start Up
0003.060	3.1.1	DASI shall consist of a control for the addition of a correction into the display of ASI.	T	X	Start Up
0003.070	3.1.1	DASI shall consist of a lamp test control.	T	X	Lamp Intensity
0007.010	3.1.2	The digital display panel shall consist of a control for varying the illumination of the display.	D	X	Lamp Intensity
0007.050	3.1.2	The digital display panel shall consist of a connector and mating connector for the signal cable.	X	I	Pre Test
0007.070	3.1.2	The digital display panel shall consist of a lamp test control.	D	X	Lamp Intensity
0015.000	3.2	If a perfectly calibrated altimeter is set to the altimeter setting indicated and existing at any given station whose elevation is designated as M _p , the pointer of the altimeter instrument shall yield an indicated altitude equal to M _p when the instrument is subjected to the pressure which exists at the elevation M _p .	T	X	Calibration
0016.000	3.3	The DASI shall be designed and constructed to meet the general requirements of FAA-G-2100e.	I	X	Pre Test
0018.020	3.3.2	A DASI system shall be defined as one sensor translator and twenty (20) remote displays.	I	X	Pre Test

TEST REQUIREMENT NUMBER	SPEC REFERENCE NUMBER	SPECIFICATION REQUIREMENTS	OT&E O	OT&E I	COMMENTS
0023.000	3.3.4	Any system component shall be interchangeable with any other system component of the same type.	D	X	FSK output & component interchangeability
0024.000	3.3.4	The system shall remain with the specified requirements when any system component is interchanged with any corresponding component.	T	X	FSK output & component interchangeability
0031.000	3.3.7	Provision shall be included in the system to permit recalibration by the FAA with FAA equipment over a suitable pressure range at the site where the equipment is installed.	T	X	Calibration
0032.000	3.3.7	Pressure couplings shall be provided to permit connection of ancillary equipment required to perform this calibration.	I	X	Pre Test
0033.010	3.4.1	Altimeter setting readings provided by the basic unit shall differ from the computed altimeter setting by no more than +/- 0.005 inches of mercury for any value in the range of the instrument.	T	X	Calibration
0033.050	3.4.3	The altimeter setting indications shall be displayed to four significant digits with no degradation of accuracy in the altimeter setting indicator.	T	X	Lamp Intensity
0033.060	3.4.3	The altimeter setting indicator shall be updated at least once each minute.	X	T	Error Detection
0040.010	3.6.1	The unit shall automatically perform this error test prior to each ASI update.	X	T	Error Detection
0041.000	3.6.1.1	An error test transmission shall be generated by the basic unit and detected at the serial output.	X	T	Error Detection

TEST REQUIREMENT NUMBER	SPEC REFERENCE NUMBER	SPECIFICATION REQUIREMENTS	OT&E O	OT&E I	COMMENTS
0041.010	3.6.1.1	This test transmission shall be compared with and found equal to a stored fixed value prior to enabling each ASI update.	X	T	Error Detection
0043.000	3.6.1.3	Upon detection of error test computation and/or serial transmission error detection, the basic unit shall output a serial word to cause the letters "ERROR" to be displayed on all of the ASI indicators.	X	T	Error Detection
0044.000	3.6.1.4	When placed in the maintenance mode, the basic unit shall continue to operate in the background.	X	T	Lamp Intensity
0044.010	3.6.1.4	In the normal operating conditions, the basic unit and all remote displays shall present the functional ASI output.	X	T	Start Up
0044.020	3.6.1.4	The remote display shall not display the self-test ASI transmission at any time.	X	D	Lamp Intensity
0045.000	3.6.1.5	If the altimeter setting indicator fails to receive two consecutive transmissions from the basic unit (or no serial output for approximately 2.5 minutes), an "ERROR" signal shall be displayed at all stations.	X	T	FSK output & component interchangeability
0046.000	3.6.2	The basic unit (3.1.1) shall be performing all functional parameters of this specification within 30 minutes of the time the unit has been connected to a 120 VAC, 60 Hz power source.	X	T	Start Up
0046.020	3.6.2	The signal output during warmup shall be ERROR	D	X	Start Up

TEST REQUIREMENT NUMBER	SPEC REFERENCE NUMBER	SPECIFICATION REQUIREMENTS	OT&E O	OT&E I	COMMENTS
0046.030	3.6.2	The display panel (3.1.2) shall perform all functional parameters of this specification within one (1) minute of the time the unit power cord has been connected to a 120 VAC, 60 Hz power source and receipt of signal from the basic unit.	X	T	Start Up
0046.040	3.6.2	Until the receipt of a signal, the display panel shall indicate "ERROR".	D	X	Start Up
0053.010	3.7.6	Calibration capability shall be provided to adjust the output by plus or minus 0.04 inches of mercury in increments of 0.001 inches.	D	X	Calibration
0053.040	3.7.6.2	The basic system shall transmit output data in an ASCII-coded FSK format.	X	T	FSK Output & component interchangeability
0055.000	3.7.8	The basic unit panel shall provide a digital readout of the altimeter setting indication.	D	X	Start Up
0058.040	3.8.2	The viewing angle shall be ± 60 degrees from the perpendicular in both the horizontal and vertical axes.	D	X	Lamp Intensity
0059.010	3.8.3	The digits shall have the capability of displaying the letters "ERROR" in addition to numerals.	D	X	Start Up
0059.020	3.8.3	The display shall have the capability of presenting altimeter setting readings of 27.00 to 32.00 inches of mercury.	D	X	Calibration
0062.000	3.8.6	The intensity of the readout shall be sufficient to permit easily reading the display from its background at a distance of 20 feet under ambient illumination conditions ranging from darkness to 10,000 foot candles.	D	X	Lamp Intensity

TEST REQUIREMENT NUMBER	SPEC REFERENCE NUMBER	SPECIFICATION REQUIREMENTS	OT&E O	OT&E I	COMMENTS
0062.010	3.8.6	An intensity control shall be provided on the front of the digital display panel.	0	X	Lamp Intensity
0062.020	3.8.6	Readouts shall remain clear and legible at all intensity control conditions.	0	X	Lamp Intensity

APPENDIX B
TEST PROCEDURES

1.1 Pretest Inspection

1.1.1 Inspection Objectives

The Pretest Inspection will verify that the DASI system meets the general requirements of FAA-G-2100e (e.g., the power cord conforming to J-C-580). The Pretest Inspection will verify the connector and mating connector for the signal cable.

The Pretest Inspection will also verify that a pressure connection is provided to permit connection to ancillary equipment.

Finally, the inspection will verify the DASI system is comprised of 1 sensor translator unit and up to 50 remote displays.

If the QRO has already verified (sign off) on this inspection during Development Test and Evaluation (DT&E), then these inspections will be waived.

1.1.2 Requirements Tested

The Pretest Inspection verifies the following DASI Specification Requirements. The test requirement number and Specification Reference paragraph are taken from the Test and Evaluation Master Plan (TEMP) Verification Requirement Traceability Matrix (VRTM).

Test Reference No.	Specification Reference Paragraph
0007.050	3.1.2
0016.000	3.3
0018.020	3.3.2
0032.000	3.3.7

1.1.3 Test Operation Instructions

Verify the following:

Pass/Fail

Meets the general requirements of FAA-G-2100e.

The DDP consist of a connector and mating connector for the signal cable.

Is a pressure connection provided to permit a connection to ancillary equipment.

The DASI system is comprised of 1 sensor translator and up to 50 remote displays.

2.1 Startup Procedure

2.1.1 Test Objective

The Startup Procedure activates the Sensor/Translator (S/T) and the Digital Display Panel (DDP).

2.1.1.1 S/T Startup

Turn on the power switch, the S/T will display the self test. A null character is then displayed as a left arrow, then the Altimeter Setting Indicator (ASI) is displayed.

2.1.1.2 DDP Startup

Turn on the power switch, the DDP will execute self test, then ERROR and then accept messages from the communication line.

2.1.2 Requirements Tested

During startup, when the elevation had never been entered into the system and when a calibration is required, the following DASI Specification Requirements will be executed:

Test Reference No.	Specification Reference Paragraph
0003.050	3.1.1
0003.060	3.1.1
0044.010	3.6.1.4
0046.000	3.6.2
0046.020	3.6.2
0046.030	3.6.2
0046.040	3.6.2
0053.010	3.7.6
0055.000	3.7.8
0059.010	3.8.3

2.1.3 Test Operation Instructions

2.1.3.1 Setup

Complete

Step 1. Plug signal cable into S/T and/or DDP and the attached power cord into a 120 volts alternating current (VAC) grounded outlet. (If cable is already attached, skip this step.)

Step 2. Plug in the communication cable to the S/T. (If the cable is already attached, skip this step.)

Step 3. Turn on power switch at both positions.

Complete

(If power is already applied, skip this step.)

Step 4. Allow 30 minutes for the S/T to stabilize.

Record start time _____ Record stop time _____

Pass/Fail

Step 5. Verify 30 minutes or less has transpired for S/T to stabilize.

Step 6. Both the S/T and DDP will execute self test. Verify the DDP performs all functional parameters within 1 minute after power is applied and then display ERROR. It then waits for messages from the S/T.

Record start time _____ Record stop time _____

Step 7. At the S/T, the stored ASI will be displayed, if it had been previously stored. Otherwise, proceed to Test Conduct 2.1.4.

Step 8. At the DDP, it will wait for a valid message from the S/T and then it displays the ASI. Otherwise, the ERROR continues to be displayed. When the ASI is displayed, proceed to Test Conduct step 4.

2.1.4 Test Conduct

Pass/Fail

Step 1. To set the elevation, press ELEV key on the keypad. Press ENTER key. Enter the airport elevation (e.g., based on the installation site) using the number keys, then press ENTER. The unit will automatically return to the ASI setting. (If calibration is necessary, proceed. Otherwise, proceed to step 3.)

Step 2. To add a calibration offset, press the MAINT key two times. The display will read OFFSET press ENTER. Use the + or - keys to enter the calibration correction offset, then press ENTER. This becomes an offset to the next ASI calculation before it is displayed. The offset is shown to be + or - 0.04 inches of mercury (inHg) in increments of 0.001 inHg. Record the offset _____.

Step 3. At the DDP, it will wait for a valid message from the S/T and then it displays the ASI. Otherwise, the ERROR continues to be displayed.

Step 4. Verify that the DDP ASI reading is the same as the S/T ASI reading.

3.1 Lamp Intensity Test

3.1.1 Test Objectives

The objective of the test is to demonstrate that the 4-digit DDPs are plainly legible when observed under lighting conditions varying from 0- to 10,000-foot candles from a distance of 20 feet, which will be varied throughout the test, and any viewing angle 60 degrees from in front of the display. This test will be run twice, during maximum daylight and again during night time hours.

3.1.2 Requirements Tested

The Lamp Intensity Test will verify the following DASI Specification Requirements taken from the TEMP's VRTM.

Test Reference No.	Specification Reference Paragraph
0003.070	3.1.1
0007.010	3.1.2
0007.070	3.1.2
0033.050	3.4.3
0044.000	3.6.1.4
0044.030	3.6.1.4
0058.040	3.8.2
0062.000	3.8.6
0062.010	3.8.6
0062.020	3.8.6

3.1.3 Test Equipment Required

Photometer

3.1.4 Test Operation Instruction

The DDP will be tested for legibility at varying settings of illumination control and repeated for ambient illumination conditions ranging from darkness to 10,000-foot candles.

3.1.4.1 Setup

Pass/Fail

Step 1. Execute the Startup Procedure 2.1.

Step 2. Verify that the DDP 4-digit ASI is displayed.

Step 3. Lower the lighting in the tower cab to total darkness.

Step 4. If necessary, increase or decrease intensity by pressing the + or - illumination control button.

Pass/Fail

Step 5. Verify that the DDP display is legible from the degrees and distances presented on the Data Form, figure 1. Fill in each distance/degree with Pass/Fail.

Step 6. Place the photometer directly in front of the DDP and turn on.

Step 7. Move the photometer to measure the ambient light.

Step 8. Increase the illumination in the tower cab until the photometer reads 10,000-foot candles or less.

Step 9. Verify that the DDP display is legible from the degrees and distances presented on the Data Form. Fill in each distance/degree with Pass/Fail.

Step 10. Are readouts clear and legible at all intensity control conditions?

To change the intensity of the S/T ASI readout, execute the following:

Step 11. Pressing INTEN key, followed by pressing either the + or - key, will cause the display intensity to increase or decrease accordingly.

Step 12. Press MAINT key three times, DIAG is displayed. During self test, ERROR is displayed at the DDP. The DDPs will not display the self test ASI.

Note: A Data Form will be required for each test.

DATA FORM

Controller's Name:

Time:

Date:

Location:

Illumination (Circle One)

- Darkness
- 10,000 Foot Candles (Max.)
- Actual Foot Candle _____
- Actual Foot Candle _____

		Degrees								
		+				-				
		60*	45	30	15	0	15	30	45	60*
D i s t a n c e	5'									
	10'									
	15'									
	20'*									

* Dependent on the Tower Cab

COMMENTS:

Controller's Signature _____

FIGURE 1. DATA FORM

4.1 Frequency Shift Keying Output and Component Interchangeability Procedure

4.1.1 Test Objective

This test will verify the output from the S/T unit to be digital data, ASCII coded, in serial Frequency Shift Keying (FSK) format. It will be shown that the four most significant digits of the DDP unit ASI display are provided by means of decoding the FSK output.

Also, the test will show that any system component will be interchangeable with any other system component of the same type.

4.1.2 Requirements Tested

This test will verify the following DASI Specification Requirements:

Test Reference No.	Specification Reference Paragraph
0023.000	3.3.4
0024.000	3.3.4
0045.000	3.6.1.5
0053.040	3.7.6.2

4.1.3 Test Equipment Required

Oscilloscope
Stop watch

4.1.4 Test Operation Instruction

This test will verify the FSK output and the component interchangeability.

4.1.4.1 Setup

Pass/Fail

Step 1. Power off the S/T and the DDP.

Step 2. Power on the DDP, the display will read
ERROR.

Step 3. Remove the top cover from the DDP and
monitor test point TP E4 with the oscilloscope.
Set frequency to 1 millisecond (ms) per division
and voltage to 2 volts per division.

Step 4. Power on the S/T unit.

Step 5. At the DDP observe the FSK data at the test
point. ERROR is displayed until three but less than
six updates have been sent.

Pass/Fail

Step 6. Power off the S/T unit.

Step 7. Use the stop watch to measure the time from S/T power off to the time the DDP display reads ERROR. Verify the elapsed time is less than 2.5 minutes.

Step 8. Power off the DDP unit.

Step 9. Replace the top cover on the DDP.

Step 10. Remove the top cover from the S/T unit.

Step 11. Remove the Power Supply Sensor/Translator Board (1A2) Assembly from the S/T unit and replace with a spare (1A2) board.

Step 12. Execute the Startup procedure (2.1).

Step 13. Verify that the DDP and S/T unit ASI reading are the same.

Step 14. Power off the DDP and S/T unit.

Step 15. Remove the Logic/Display board (1A1) from the S/T unit and replace with spare 1A1 board.

Note: The elevation and offset (if needed) must be entered.

Step 16. Execute the Startup procedure (2.1).

Step 17. Verify the DDP and S/T unit ASI reading are the same.

Step 18. Power off the DDP and S/T unit.

Step 19. Replace the top cover on the S/T unit.

5.1 Calibration Tests

5.1.1 Test Objectives

This test will verify the calibration requirements for the DASI system. The tests will be at selected points not greater than ± 0.005 inHg for any value in the range of the instrument.

The provision to permit recalibration by the FAA will be tested. The recalibration offset will be shown to be ± 0.04 inHg in increments of 0.001 inHg.

5.1.2 Requirements Tested

This test will verify the following DASI Specification Requirements:

Test Reference No.	Specification Reference Paragraph
0015.000	3.2
0031.000	3.3.7
0033.010	3.4.1
0059.020	3.8.3

5.1.3 Test Equipment Required

Portable Pressure Standard
Variable Pressure Test Fixture

5.1.4 Test Operation Instruction

This test will verify the calibration requirements for the DASI system.

5.1.4.1 Setup

Pass/Fail

Step 1. Connect the S/T unit to the Pressure Standard and Variable Pressure Test Fixture using the rigid pipe and coupling supplied with the test fixture.

Step 2. Apply power to the Pressure Standard. Allow 30 minutes for the unit to stabilize. Record start time _____. Record stop time _____. Verify time is within 30 minutes. _____

Step 3. Apply power to the S/T and DDP. Allow 30 minutes for the units to stabilize. Record start time _____. Record stop time _____. Verify time is equal to or less than 30 minutes. _____

Pass/Fail

Press the MAINT key twice and OFFSET is displayed.
Press ENTER key and the OFFSET is displayed.
Record the value. _____

Step 4. Press ELEV key on keypad, press ENTER.
Enter the elevation 4,000 feet using the keypad,
then press ENTER. The unit will return to the
ASI setting display.

Step 5. Adjust the pressure using the hand pump
on the test fixture so that the S/T ASI reads 27.0
InHg +/-0.01. Record value _____.

Record the Pressure Standard reading _____.
Record Calculated ASI reading _____.

Step 6. Press ELEV key on the keypad, press
ENTER. Enter the elevation 8,000 feet using the
keypad, then press ENTER.

Step 7. Adjust the pressure using the hand pump
on the test fixture so that the S/T unit ASI reads
31.00 inHg +/- 0.01. Record value _____.

Step 8. Record the Pressure Standard reading _____.
Record Calculated ASI reading _____.

Step 9. Verify that the DDP ASI reading is the same
as the S/T and Pressure Standard reading. _____

Step 10. Verify that the ASI reading on the S/T
does not differ by more than + or - 0.005 inHg
from the computed value. _____

Step 11. Switch the S/T unit power off and disconnect
pressure test fixture and pressure standard.

Using the pressure readings recorded from the Pressure Standard, calculate
the equivalent ASI values for all elevation settings recorded.

The formula is as follows:

$$ASI = (P * (1 + ((29.921/P)^{0.1902632}) * (0.0019812 * H / 288.16))^{5.255877}) + C$$

Where:

ASI - Altitude Setting Indication

P - True pressure at the levation of the sensor

H - Elevation in geopotential meters above mean sea level

C - Offset entered

6.1 Error Detection Test Procedure

6.1.1 Test Objective

This test will verify the computation and serial transmission errors. Upon power on, the DDP will display ERROR until three consecutive matching ASI values arrive from the S/T unit. Parity is checked on all incoming words and a parity error will cause the ERROR to be displayed. If no message arrives at the DDP within 2.5 minutes, the DDP will display ERROR. The DDP requires no warm up period. The test also demonstrates that the S/T unit, after self test reads the pressure sensor, displays the correct ASI. A computation check is run on a known ASI value before each calculation is made to verify the integrity of the system. ERROR will be displayed if the test computation produces an invalid result. If an incomplete response is received from the sensor, the S/T unit will display ERROR.

Maintenance mode operations does not stop the operation of the system and ERROR is not displayed during maintenance mode operations. If an error is detected during maintenance mode, ERROR will be displayed on all units.

6.1.2 Requirements Tested

This test will verify the following DASI Specification Requirements:

Test Reference No.	Specification Reference Paragraph
0033.060	3.4.3
0040.010	3.6.1
0041.000	3.6.1.1
0041.010	3.6.1.1
0043.000	3.6.1.3
0045.000	3.6.1.5

6.1.3 Test Equipment Required

- Oscilloscope
- Stopwatch
- IBM compatible with/Windows
- DASI DDP test fixture
- Disk with DASI test software (DASIERR)

6.1.4 Test Operation Instruction

This test will verify the error detection capability requirements for the DASI system.

6.1.4.1 Set up

Pass/Fail

Step 1. Execute the Startup Procedure (2.1).

Step 2. Power off the S/T unit.

Step 3. Remove the cover from the DDP.

Step 4. Monitor test point TP E4 with the oscilloscope. Set the Frequency to 1 ms per division and voltage to 2 volts per division.

Step 5. Power on the S/T unit.

Step 6. Observe the FSK data at the test point and note the DDP continues to display ERROR until three but less than six updates have been sent.

Step 7. Verify that the message is sent by the S/T at least once per minute.

Step 8. Power off the S/T unit.

Step 9. Use the stop watch to measure the time from S/T power off to the time the DDP reads ERROR. Verify the elapsed time is less than 2.5 minutes.

Step 10. Remove the top cover of the S/T unit. Disconnect the sensor unit and connect the serial cable from the PC to the S/T sensor input line.

STEP 11. Power on the PC and start Windows.

Step 12. Insert test program in drive A, select Program Manager from menu. From the drop down menu select RUN and type a A:/DASIERR. Press ENTER.

Step 13. From the menu, select TEST A S/T UNIT, then select START TEST command.

Step 14. Power on the S/T unit.

Step 15. Enter 0 foot elevation using the keypad, then press ENTER.

Step 16. Verify that the PC, S/T, and DDP ASI are the same value.

Step 17. From the menu select SEND ERROR.

Pass/Fail

- Step 18. Verify that the S/T display reads a random value. _____
- Step 19. Verify at the DDP within 2.5 minutes it reads the same value. _____
- Step 20. From the menu select SEND GOOD.
- Step 21. Verify the PC, S/T, and DDP values are the same. _____
- Step 22. From the menu select END TEST.
- Step 23. Verify the DDP reads ERROR within 2.5 minutes. _____
- Step 24. Power off the S/T, disconnect PC, and put top cover back.
- Step 25. Power on the S/T unit.
- Step 26. Connect the PC, DASI test fixture to the DDP.
- Step 27. Power on the PC, test fixture, and DDP.
- Step 28. Start Windows.
- Step 29. Insert test program in drive A. Select Program Manager from the menu. From the drop down menu select RUN and type A:DASIERR. Press enter.
- Step 30. From the menu select TEST SOME DDP UNITS then START TEST command.
- Step 31. Verify the DDP and PC values are the same. _____
- Step 32. From the menu select SEND ERROR.
- Step 33. Verify the DDP display reads ERROR. _____
- Step 34. From the menu select SEND GOOD.
- Step 35. Verify the PC and DDP values are the same. _____
- Step 36. From the menu select END TEST.
- Step 37. Verify the DDP reads ERROR within 2.5 minutes. _____
- Step 38. Disconnect the PC and DASI test fixture.

7.1 Maintainability Test

7.1.1 Test Objectives

This procedure evaluates the Mean Time to Repair (MTTR) compliance. The test will ensure that failure cannot exceed 30 minutes MTTR for each Line Replaceable Unit (LRU). The MTTR is the total time required to diagnose the problem, replace the LRU, and subsequently check out the system.

7.1.2 Requirement Tested

The Maintainability test will verify the MTTR requirement as is called out in the TEMP in paragraph 3.3.2.2.

7.1.3 Test Equipment Required

Stopwatch

7.1.4 Test Operation Instruction

The Maintainability Demonstration will consist of a DASI system in operation (Note: The system must be logged out of service for air traffic operation). The OT&E Test Director will then cause various problems to the system as described in Test Conduct.

7.1.5 Test Conduct

Failures to be induced, diagnosed, and repaired include:

a. Power Supply Sensor/Translator Board (1A2) Assembly

A failure will be induced to simulate a failed Power Supply S/T Board Assembly. A technician will be utilized to diagnose and repair the problem. The beginning time for this test will be recorded as zero and a stopwatch will be started in order to measure the elapsed time for the notification, diagnosis, and repair of the problem. When the problem has been fixed the stopwatch will be stopped and the time elapsed will be recorded as the length of time for the repair.

b. Logic/Display Board (1A1)

A failure will be induced to simulate a failed Logic Display Board. A technician will be utilized to diagnose and repair the problem. The beginning time for this test will be recorded as zero and a stopwatch will be started in order to measure the elapsed time for the notification, diagnosis, and repair of the problem. When the problem has been fixed, the stopwatch will be stopped and the time elapsed will be recorded as the length of the time for the repair.

c. Digital Display Panel

A failure will be induced to simulate a failed DDP. A technician will be utilized to diagnose and repair the problem. The beginning time for this test will be recorded as zero and a stopwatch will be started in order to measure the elapsed time for the notification, diagnosis, and repair of the problem. When the problem has been fixed, the stopwatch will be stopped and the time elapsed will be recorded as the length of time for the repair.

7.1.5.1 Setup

a. At the S/T unit, remove the cover and induce the fault on the Power Supply Sensor/Translator board.

Pass/Fail

Step 1. Record the start time the instant the failure is induced by the OT&E Test Director.
Record Time _____.

Step 2. Notify the ACF Maintenance Specialist and that Specialist replaces the failed LRU.

Step 3. Isolate the failure and replace the LRU.

Step 4. Record the time that the DASI system is operational _____.

b. At the S/T unit, remove the cover and induce the fault on the Logic/Display board.

Note: The elevation and offset (if needed) must be entered.

Repeat steps 1-4

Step 1 Record time _____
Step 4 Record time _____

c. At the Digital Display, induce fault on one DDP.

Repeat steps 1-4

Step 1 Record time _____
Step 4 Record time _____

8.1 Lightning Protection/Electromagnetic Compatibility

8.1.1 Test Objectives

Protection from radiated transients and surges from externally exposed power, signal control, and status lines shall be the responsibility of the respective airport civil engineering safety inspectors. Electromagnetic compatibility testing shall be accomplished during OT&E Operational Testing. Testing will consist of observing any electromagnetic interference on other equipment in the immediate area of 10 feet.

8.1.2 Requirement Tested

The Lightning Protection/Electromagnetic Compatibility demonstration will verify the requirement called in the TEMP in paragraph 3.5.2.3.

8.1.3 Test Equipment Required

N/A

8.1.4 Test Conduct

Electromagnetic compatibility testing will consist of looking for interference on other equipment displays while the DASI is operating. The equipment specification requires the contractor to demonstrate that the DASI equipment will not cause interference with collocated equipment during Installation Check out and Acceptance Testing.

Electronic interference should not be observed on any FAA equipment located near the DASI equipment. Any electronic interference of any nature will be investigated.

9.1 Meteorological Performance Evaluation

9.1.1 Test Objectives

Operational testing will be needed to ascertain the accuracy of DASI performance and ensure consistency between DASI and a certified sensor are consistent. The operational test is required to verify that the sensor provides a sensor accuracy within +/- 0.01 inHg in an operational environment.

9.1.2 Requirement Tested

The Meteorological Performance Evaluation will verify the requirement called out in the TEMP in paragraph 3.5.2.1.

9.1.3 Test Equipment Required

N/A

Pass/Fail

9.1.4 Test Conduct

The Meteorological Performance Evaluation will consist of reading the S/T ASI value at Page Field (FMY) and call Southwest Regional Airport (RSW) to get their ASI reading for comparison. Is the sensor accuracy within +/- 0.01 inHg.
